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Ask a Scientist: How can people have an impact on the global climate?

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Courtesy of The University of Tennessee, Knoxville.
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Try searching the internet for a definition of “global climate.” It’s nearly impossible to find anything that is about global climate and not global climate change. Literally, when we tried, it wasn’t until the sixth page of our Google search results that we managed to find a website that discussed what global climate actually is and not whether or not it’s changing (Thank you, windows2universe.org).

This was unbelievable to us. So many of us talk about climate change, but do we even have a strong understanding of what a climate is? Before answering questions like, “How can people have an impact on global climate?” it’s really necessary to answer the question, “What is global climate?”

Climate is distinguished from weather because it’s the average of weather patterns in an area over 30 or more years. If you took a drive to Gatlinburg, and it was raining and 70 degrees there, its weather would be rainy and 70 degrees.

But let’s say Gatlinburg is humid and has a temperature that ranges from 43-85 degrees over a longer period of time. Climatologists would then say that Gatlinburg has a “humid subtropical” climate. Among many different labels, climate classifications tell us what usually happens in an area, though not necessarily what’s going on right now. For example, you can have rainy days in a dry climate because a few rainy days aren’t enough to change a 30-year pattern of dry weather.

But what determines a climate? Well, ultimately, the sun does.

Climates are formed by what happens to the massive amounts of solar energy emitted by the sun once it hits the Earth. So what exactly can solar energy do?

Imagine your car has been sitting in the sun all day with all the windows closed. What is the temperature inside your car? It’s really hot! This is one of the most basic aspects of climate: Solar energy heats air. Places that are close to the sun, in particular those along the equator, get a lot of solar energy and are hotter. Places that are far from the sun, like the North and South Poles, don’t get a lot of solar energy and are much colder.

However, climate obviously isn’t that simple. There are a lot of other factors that change what happens to solar energy. At high elevations, gases can use energy to expand, and this makes higher elevation climates cooler. Water can use solar energy to evaporate, which make places near water cooler and places without water, like deserts, very hot. Evaporated water is also what generates rainfall — meaning solar energy produces rain, too.

Additionally, solar energy isn’t evenly distributed across the globe, because land isn’t flat. This creates temperature differences in the air, which creates air currents. These air currents carry rainfall, and since the land features that drive temperature changes and air currents are pretty constant, the places that get rainfall are pretty constant, too. This is why there are wet and dry climates.

So, basically, the geography of our planet affects the way solar energy is used in different areas, ultimately creating climates. What does all this mean for global climate?

Well, global climate is a global measure of how much solar energy is being used and how much is generating heat in our atmosphere. This means that in order to affect the global climate, humans would have to affect the use and distribution of solar energy all across Earth.

We know that sounds like an incredible feat. Are humans really capable of such a task? The answer is yes, because of one thing we haven't mentioned yet but which you have most likely heard of — greenhouse gases. Greenhouse gases, most notably carbon dioxide (CO_2), are gases that absorb and emit more energy than other gases in our atmosphere (like oxygen and nitrogen).

They cause the warming effect, which makes the global climate increase. Every greenhouse gas in the atmosphere increases the amount of energy all of the other greenhouse gases have access to. Instead of reflecting the solar energy, these gases not only get hotter themselves but heat each other. The effect stacks up, and it keeps stacking up as more greenhouse gases are added to the atmosphere, causing the planet to become hotter and hotter.

We've known about the ability of CO_2 to store energy for many decades, thanks to a study by published in 1896 by a scientist named Svante Arrhenius. Since then, many more studies have confirmed this finding, and it's widely agreed upon amongst scientists. But scientists didn't always think of greenhouse gases as villains because they are actually very important for Earth. Without them, the energy from the sun would not be enough to keep our planet as warm as it needs to be to support life.

But you know what they say about too much of a good thing, and that's where humans come into the picture. We do a lot of things that make CO_2 and other greenhouse gases – and we do mean a lot. Think about it: We emit CO_2 all the time.

Whether we're driving cars, using the stove, rearing animals for food or even brewing beer, most things we do that require energy release CO_2. That isn't necessarily a bad or a good thing: After all, energy drives civilization. It's because of this energy that we've massively increased life expectancy, cured many diseases and gotten millions of people access to food, water and education. But along with all this progress, we've seen an unprecedented CO_2 spike in what is known as the "hockey stick" graph. Even in our oldest records of the Earth's CO_2 levels, we've never seen anything like it. Something is up, and let's be honest — we're probably the culprits.

Of course, greenhouse gases are natural, and there are ways to eliminate them. But we're producing way more greenhouse gases than it is possible to eliminate, and that's how humans impact global climate. Our greenhouse gas production makes the heat-producing solar energy in our atmosphere a lot stronger and a lot hotter.

Even more importantly, this change in solar energy use will have downstream effects on all the other climate-forming systems. It will change the air currents, which will change the rainfall, which will change the plants and the water, which will eventually change the land itself until not just the global climate but the climates all across the globe are no longer what they are now.

Climate change is a contentious topic, particularly in today's politically charged environment. But as scientists, we can't ignore the data, and the data suggests that we are impacting global climate. Atmospheric samples contained in ice cores provide just one line of evidence that atmospheric CO2 has increased since the Industrial Revolution.

So what can we do?

To start, you can reuse and recycle, find alternatives to driving, support clean energy sources and, believe it or not, have fewer babies! Check out cotap.org for even more ways you can reduce your carbon footprint.

Have a question for Ask a Scientist or want to join our organization? Contact us by email at askasci@utk.edu or tweet us at @AskAScientistUT! Check us out on VOLink for sources used in this article and upcoming events we'll be hosting.

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